United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Importation of Chinese Penjing

into the United States

With Particular Reference to *Ehretia microphylla*

2003 Supplementary Assessment

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September 10, 2003

Executive Summary

This pathway-initiated commodity risk assessment examines the risks associated with the proposed importation of penjing plants of *Ehretia microphylla*, in approved growing media, from the People=s Republic of China into the United States. The quarantine pests that are likely to follow the pathway are analyzed using the methodology described in the USDA, APHIS, PPQ Guidelines 5.02 which examines pest biology in the context of the Consequences of Introduction and the Likelihood of Introduction and estimates the Pest Risk Potential. There are quarantine pests that can potentially follow the pathway on these plants. The pests include one arthropod, two mollusks, seven fungi and three nematodes. The Pest Risk Potential is rated for each of the organisms and is summarized in the table below.

Pest	**Pest Risk Potential**
ARTHROPODA	
Rhizoecus hibisci Kawai & Takagi (Homoptera: Pseudococcidae)	High (28)
MOLLUSCA	
Acusta ravida (Benson) (Bradybaenidae)	High (30)
Succinea horticola Reinhart (Succineidae)	High (30)
FUNGI	
Macrophoma ehretiae	Medium (22)
Phakopsora ehretiae	Medium (20)
Pseudocercospora ehretiae-thyrsiflora	Medium (19)
Pseudocercosporella ehretiae	Medium (19)
Uncinula ehretiae	Medium (21)
Uredo ehretiae	Medium (20)
Uredo garanbiensis	Medium (20)
NEMATODA	
Xiphinema brasiliense Lordello (Xiphinematidae)	Medium (24)
Tylenchorhynchus crassicaudatus Williams (Belonolaimidae)	Medium (25)
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee & Dasgupta (Belonolaimidae)	Medium (25)

In this document, a number of exotic, polyphagous pests intercepted in Europe on unspecified Abonsai@ plants are assumed to be potential pests of *Ehretia microphylla* (EPPO, 1996a, b). The following pests, analyzed in 1996 using the PPQ Guidelines version 4.0 criteria and then current literature, are now not considered likely to follow the pathway of the importation based on a reexamination of their reported host ranges: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis* (*G. africana* or *G. africans*), *Helicoverpa armigera*, *H. assulta*, *Icerya seychellarum*, *Mamestra brassicae*, *Phyllophaga titanis*, *Spodoptera litura*, *Sympiezomias velatus*, and *Tridactylus japonicus*.

The accompanying pest risk management document considers the reduction of risk that will occur when existing regulations on the importation of plants in APHIS-approved growing media (7 CFR ' 319.37-8) and proposed additional mitigation measures are applied to the importation of

Ehretia microphylla penjing plants in growing media from the People's Republic of China. The safeguards will effectively remove the pests of concern from the pathway and allow the importation of these plants to be associated with no more pest risk than is associated with currently permitted bare-root importations.

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I. Introduction

This pest risk assessment (PRA) was conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (USDA, APHIS, PPQ, CPHST, PERAL) to examine the plant pest risks associated with the importation of artificially dwarfed plants of *Ehretia microphylla* established in an APHIS-approved growing medium from the People's Republic of China into the United States. The purpose of this document is to update an earlier version (Cave and Redlin, 1996).

The art of artificially dwarfing plants is a time-consuming and highly labor-intensive activity. The resulting plants range from approximately four inches to 60 inches in height, and the value may range from $10 to $10,000 per plant. The median price of an artificially dwarfed plant is close to $100 and varies with the age of the plant regardless of size. Plants imported from Asia (Japan, the People's Republic of China and the Republic of Korea) represent approximately 80 percent of the value of the entire artificially dwarfed plant market in the United States (Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1)).

Authority for APHIS to regulate plant pests/plant products is derived from the Plant Protection Act of 2000 (7 USC '' 7701 *et seq*.) and the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR ' 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products). The risk assessment methodology and rating criteria and the use of biological and phytosanitary terms is consistent with international guidelines (FAO, 2001, 2002; NAPPO, 1995) and current agency guidelines (APHIS, 2000).

II. Risk Assessment

A. Initiating Event: Proposed Action

This commodity-based, pathway-initiated pest risk assessment is prepared in response to a request from the Chinese Animal and Plant Quarantine Service (ASIQ) to change current regulations to allow increased types of importations of artificially dwarfed penjing plants of *E. microphylla* from China into the United States. This is a potential pathway for the introduction of plant pests. The entry of bare-root *E. microphylla* from China into the United States is currently regulated under 7 CFR ' 319.37, and does not explicitly prohibit the importation of naturally dwarf plants under 305 millimeters in length or artificially dwarfed plants. This lack of restrictions allows such plants to enter the United States if the plants are accompanied by a phytosanitary certificate of inspection.

The USDA carefully assesses requests to change regulations related to propagative materials because the importation of propagative material in growing media raises unique phytosanitary concerns. Specifically, some biological contaminants may not be discernable during pre-shipment and Port of

Entry visual inspections. This inability to non-destructively inspect may increase the potential for the introduction of some exotic organisms. Treatment of growing media may not rid the media of organisms in the absence of specific guidelines, and the possibility of pest infestation/reinfestation of Aclean@ plants in the absence of specific safeguards exists.

During the past decade, China has exported significant volumes of bare-root bonsai plants into the United States under the existing regulations. In August 1992, representatives of the China Animal and Plant Quarantine Service (ASIQ) requested permission to export penjing plants established in APHIS-approved growing media. A list of 112 plant species was submitted. These plants were categorized by PPQ as Aprohibited@, Apost-entry quarantine@, and Arestricted@. In January 1994, ASIQ was asked to select five species for pest risk analysis. Subsequently, ASIQ submitted a list of eight species, and provided a list of pests or potential pests associated with these plants. In April 1994, PPQ staff identified five plant species as candidates for pest risk assessments: *Buxus sinica* (Buxaceae), *Ehretia* (*Carmona*) *microphylla* (Boraginaceae), *Podocarpus macrophyllus* (Podocarpaceae), *Sageretia thea* (*theazans)* (Rhamnaceae), and *Serissa foetida* (Rubiaceae). The risk assessment for *S. thea* was completed in September 1996 using agency guidelines 4.0 (APHIS, 1995). A Proposed Rule was published in 65 Fed. Reg 183 (Docket Number 00-042-1) on September 20, 2000. Compliance with the Endangered Species Act necessitated PPQ consultation with the US Fish and Wildlife Service (USFWS). Additional documentation was provided separately to the USFWS. These documentary requirements created a need to re-examine and update the original risk assessment for *E. microphylla*.

The updates that resulted from consultations with USFWS and public comments, created a need to re-examine and update the original risk assessment for *E. microphylla*. This update excluded the analysis of a number of exotic, polyphagous insects, analyzed in the 1996 document. The following pests are generalist feeders that were not listed as present on *Ehretia* in Chinese penjing gardens (China, 1995): *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis*, *Helicoverpa armigera*, *H. assulta*, *Icerya seychellarum*, *Mamestra brassicae*, *Phyllophaga titanis*, *Spodoptera litura*, *Sympiezomias velatus*, and *Tridactylus japonicus* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Ehretia* is not a host of these pests. In 1996, some of these pests were assessed as following the pathway due to their generalist habits, but current information shows that these pests are not likely to follow the pathway of this importation.

The volume of artificially dwarfed and other dwarf plants imported into the United States increased in recent years from fewer than 600 plants in 1993 to over 54,000 plants in 1998. Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1). The Rule was designed to reduce the risks associated with field-collected plants that are produced quickly in their country of origin for mass export. Importation of Artificially Dwarfed Plants 67 Fed. Reg. 53727-53731

(2002) (Docket No. 00-042-2). These field-grown plants include species that, historically, were not imported as artificially dwarfed plants and that may not be given the same meticulous care and safeguards as traditional artificially dwarfed plants. The rule also requires that the plants are grown for at least two years in a greenhouse or screen-house in approved nurseries that are inspected annually, and that phytosanitary certificates accompany the plants. Artificially dwarfed plants grown in fields prior to their 2-year greenhouse/screen-house growth period are required to be produced with specific safeguards to protect against infestation by longhorned beetles (Coleoptera: Cerambycidae).

B. Assessment of the Weed Potential of *Ehretia microphylla*

If the species considered for import poses a risk as a weed pest, then a "pest-initiated" risk assessment is conducted. The results of this screening of *E. microphylla* did not prompt a pest-initiated risk assessment because the evaluation concluded that there is not a significant weed potential for this species. Additionally, although not native to the United States, these plants are limited to indoor habitats throughout much of the country and are not regularly grown outdoors in unmanaged habitats (NRCS, 2003) (Table 1).

Table 1. Weed Potential of *Ehretia microphylla*

Commodity: *Ehretia microphylla* (Boraginaceae)
Synonyms used in trade: *Ehretia buxifolia* Roxb.; *Carmona microphylla* (Anon., 2003; Faucon, 2003)

Phase 1: There are 39 genera in this family including: *Borago, Carmona, Heliotropium, Mertensia* and *Symphytum* (NRCS, 2003). Ehretia is a pantropical genus of about 50 species, with a center of diversity in tropical Asia (Miller, 1989). Currently, three new world species are recognized and used in cultivation (Miller, 1989): *E. anacua* (Teran and Berl) Johnston, *E. latifolia* D.C. and *E. tinifolia* Miers. Species described as suitable for bonsai (but not analyzed in this document) include: *E. anacua, E. dicksonii* and *E. thrysifolia* (Anon., 2003; Caine and Zane, 2003).

Phase 2: Is the genus listed in:

- NO Geographical Atlas of World Weeds (Holm *et* al., 1979)
- NO World's Worst Weeds (Holm *et al*., 1977) or World Weeds: Natural Histories and Distribution (Holm *et al*., 1997)
- NO Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982)
- NO Economically Important Foreign Weeds (Reed, 1977)
- NO Weed Science Society of America list (WSSA, 1989)
- NO Is there any literature reference indicating weed potential, *e.g.* AGRICOLA, CAB Biological Abstracts, AGRIS; search on "*Ehretia*" combined with "weed").

Phase 3: *Ehretia microphylla* is not reported as a weed and is generally limited to indoor habitats in the United States.

C. Prior Risk Assessments, Current Status and Pest Interceptions

Currently, artificially dwarfed plants of *Ehretia* species may be imported as bare-root plants (7 CFR ' 319.37). The risk assessment for *E. microphylla* in growing media was completed in September 1996, and a Proposed Rule was promulgated (65 Fed. Reg. 56803-56806 on September 20, 2000). In addition, endangered species concerns necessitated consultations with the U.S. Fish and Wildlife Service. Additional mitigation measures applicable to artificially dwarfed plants in growing media were promulgated in a Final Rule (67 Fed. Reg. 53727-53731 on April 19, 2002) developed in response to interceptions of beetles. All mitigation measures in 67 Fed. Reg. 53727-53731 (2002) apply to *E. microphylla* plants that are over two years old. Interceptions of pests on bare-root *Ehretia microphylla* are summarized in Table 2.

Table 2. Pest interceptions on bare-root *Ehretia* (*Carmona*) *microphylla* from China from 1985 to 2003. All interceptions occurred once in the indicated year unless otherwise noted.

Pest	Dates
Aphis sp.	1988
Coccidae sp.	1994, 1996
Colletotrichum sp.	1992
Cucurlionidae sp.	1992
Helicarionidae sp.	2000
Leptosphaeria sp.	1991
Microsphaeropsis sp.	1997
Opeas sp.	2000
Phoma sp.	2001
Phomopsis sp.	1992, 1996, 1999, 2003
Phycitinae sp.	1998 (twice)
Pieris canidia	1991
Pseudaulacaspis sp.	1994
Sassetia sp.	1986
Succinea horticola	1993
Succinea sp.	2000

D. Pest Categorization

The pests associated with *E. microphylla* in China are listed in Table 3. This list identifies: (1) the presence or absence of these pests in the United States, (2) the generally affected plant part or parts, (3) any additionally important hosts, (4) the quarantine status of the pest with respect to the United States, (5) whether the pest is likely to follow the pathway to enter the United States, and (6) pertinent citations for either the distribution or the biology of the pest. Because of specific characteristics of given pest's biology and distribution, many organisms are eliminated from further consideration as sources of phytosanitary risk on *E. microphylla* from China because they do not satisfy the FAO definition of a quarantine pest (FAO, 2002).

Only those quarantine pests that are likely to follow the pathway are further analyzed. A quarantine pest is, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 2002). Pests not of potential economic importance, lacking the distribution requirements, or not under official control cannot be analyzed beyond listing in Table 3 because they do not meet internationally agreed criteria (FAO, 2001). For this same reason, organisms that are not agents injurious to plants (FAO, 2002) cannot be analyzed for phytosanitary concern.

Some of the quarantine pests listed in Table 3 may be potentially detrimental to the agricultural systems of the United States. There are a variety of reasons for not subjecting them to further analysis. Examples include, but are not limited to the following: non-fertile life stages can be transported in a shipment but are unable to establish viable populations upon entry into the United States, pests can become associated with the commodity because of packing or handling procedures (biological contaminants), or the pests may be associated with the commodity but will not remain with it during transport or processing. Insects with inherent mobility (wings, legs, etc.) and/or the instinct to avoid light or human activity will not remain with the commodity. In contrast, quarantine pests that are unable to leave the commodity may have immobile or cryptic life stages and can follow the pathway.

Table 3. Pests Associated with *Ehretia microphylla* in China.

Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
ARTHROPODA						
Tarsonemidae						
Xenotarsonemus biangulus Lin	CN	Unknown	Bark	No	Yes	Lin *et al*., 2000
Tetranychidae						
Tetranychus kanzawai Kishida (= *T. hydrangeae* Pritchard & Baker)	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1995; Kondo *et al*., 1987; Navajas *et al*., 2001; Osakabe, 1967; Tseng, 1990

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Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
COLEOPTERA						
Curculionidae						
Cucurlionidae sp.[6]	CN, US[6]	Various	Whole plant	Yes	Yes	PIN 309, 2003
Sympiezomias velatus Chevrolet[4]	CN	Polyphagous	Whole plant	Yes	No[4]	China, 1995
Scarabaeidae						
Adoretus sinicus Burmeister[4]	CN, US (HI)	Polyphagous	Leaf, Root	Yes	No[4]	7 CFR ' 318.13(a); China, 1995; INKTO #89
Amphimallon solstitialis (L.)[4]	CN	Polyphagous	Leaf, Root	Yes	No[4]	Browne, 1968; China, 1995; CIE, 1979; INKTO #99
Anomala corpulenta Motschulsky[4]	CN	Polyphagous	Leaf, Root	Yes	No[4]	China, 1994, 1995
Anomala cupripes Hope[4]	CN	Polyphagous	Leaf, Root	Yes	No[4]	China, 1994, 1995; Gordon, 1994
Phyllophaga titanis Reitter[4]	CN	Polyphagous	Leaf, Root	Yes	No[4]	China, 1994, 1995; Gordon, 1994
HOMOPTERA						
Aleyrodidae						
Aleurocanthus spiniferus Quaintance[1]	CN, US HI)[1,5]	Polyphagous	Fruit, Leaf	No[5]	Yes	China, 1994, 1995; CIE, 1976; INKTO #14; 7 CFR 318.13(a)
Aphididae						
Aphis gossypii Glover	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1995; CIE, 1968; Patch, 1938; Smith and Parron, 1978; Wilson and Vickery, 1981;
Aphis sp.[6]	CN, US[6]	Various	Leaf, Stem	Yes	Yes	China, 1995; PIN 309, 2003
Myzus persicae (Sulzer)	CN, US	Polyphagous	Leaf	No	Yes	Blackman and Eastop, 2000; China, 1994; Zhang and Zhong, 1983
Coccidae						
Coccidae sp.[6]	CN, US[6]	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
Coccus hesperidium Linnaeus	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Coccus viridis (Green)	CN (Taiwan), US (FL, HI,	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003

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Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
	PR, VI)					
Parasaissetia nigra (Nietner)	CN(Taiwan), US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Saissetia coffeae (Walker)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Saissetia olea (Olivier)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Saissetia sp.[6]	CN, US[6]	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
Diaspididae						
Aonidiella taxus Lenonardi	CN, US	*Cephalotaxus, Podocarpus, Taxus*	Leaf, Stem	No	Yes	EPPO, 1996b; Lattin, 1998; Nakahara, 1982
Pseudaulacaspis pentagona (Targioni Tozzetti)	CN, US	Polyphagous	Leaf, Stem	No	Yes	ScaleNet, 2003
Pseudaulacaspis sp.[6]	CN, US[6]	Polyphagous	Leaf, Stem	Yes	Yes	PIN 309, 2003
Margarodidae						
Drosicha corpulenta (Kuwana)[4]	CN	Polyphagous	Root, Stem	Yes	No[4]	China, 1994, 1995; Shiraki, 1952
Icerya aegyptiaca (Douglas)[4]	CN	Polyphagous	Leaf, Stem	Yes	No[4]	China, 1995; CIE, 1996; INKTO #119; Williams, 1985
Icerya purchasi Maskell	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; CIE, 1971; Myer, 1978; Salama *et al*., 1985
Icerya seychellarum (Westwood)[4]	CN	Polyphagous	Leaf, Stem	Yes	No[4]	China, 1995; CIE, 1955; PNKTO #21
Pseudococcidae						
Rhizoecus hibisci Kawai & Takagi	CN, US (FL, HI)[1, 5]	Polyphagous	Root	No[5]	Yes	EPPO, 1996a; ScaleNet, 2003
Rhizoecus sp.	CN	Various	Root	Yes	Yes	EPPO, 1996a
LEPIDOPTERA						
Noctuidae						
Agrotis segetum (Denis & Schiffermuller)[4]	CN	Polyphagous	Leaf, Root, Stem	Yes	No[4]	Carter, 1984; China, 1995; INKTO #25
Chrysodeixis chalcites (Esper)[4]	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No[4]	China, 1995; CIE, 1977; Goodey, 1991; Taylor, 1980
Helicoverpa armigera (Hübner)[4]	CN	Polyphagous	Inflor., Fruit, Leaf, Stem	Yes	No[4]	Avidov and Harpaz, 1969; China, 1995; CIE, 1993
Helicoverpa assulta (Guenée)[4]	CN	Polyphagous	Inflor., Fruit, Leaf, Stem	Yes	No[4]	China, 1995; CIE, 1994

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Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Mamestra brassicae (L.)[4]	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No[4]	China, 1995; INKTO #61
Spodoptera litura (F.)[4]	CN	Polyphagous	Leaf, Root, Stem	Yes	No[4]	China, 1995; CIE, 1993; PNKTO #24
Pieridae						
Aporia crataegi L.[4]	CN	Polyphagous	Leaf	Yes	No[4]	Anon., 1972; China, 1995; INKTO #149
Pieris canidia (Sparrm.)	CN	*Alstonia, Arabis, Brassica, Cardamine, Cleome, Lepidium, Rhaphanus, Rorippa*	Leaf	Yes	Yes	PIN 309, 2003
Pyralidae						
Conogethes punctiferalis (Guenée)[4]	CN	Polyphagous	Fruit, Leaf, Stem	Yes	No[4]	China, 1995; INKTO #19
Phycitinae sp.[6]	CN, US[6]	Polyphagous	Fruit, Leaf, Stem	Yes	Yes	PIN 309, 2003
ORTHOPTERA						
Gryllotalpidae						
Gryllotalpa orientalis Burmeister (= *G. africana* Palisot de Beauvois)[4, 5]	CN, US (HI)	Polyphagous	Root	No[5]	No[4]	China, 1995; Hua, 2000; INKTO #197
Trydactilidae						
Tridactylus japonicus de Hoan [4]	CN	Polyphagous	Root	No	No[4]	China, 1994; 1995; Shiraki, 1952
FUNGI						
Colletotrichum sp. (Fungi Imperfecti, Coelomycete)	CN, US[6]	Various	Leaf	Yes	Yes	PIN 309, 2003
Dennisiella babingtonii (Berk.) Batista & Cif. Anamorph: *Microxiphium fagi* (Pers.) S. J. Hughes (= *Capnodium foolii*) (Ascomycetes, Dothideales)	CN, US	*Buxus, Ilicium, Sageretia*	Leaf	No	Yes	China, 1992; Farr *et al*., l989
Leptosphaeria sp. (Ascomycetes, Dothideales)[6]	CN, US[6]	Various	Stem	Yes	Yes	PIN 309, 2003

Table 3. Pests Associated with *Ehretia microphylla* in China.						
Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Macrophoma ehretiae Cooke & Mass. (Fungi Imperfecti, Coelomycetes)	CN	*Buxus*	Leaf	Yes	Yes	Anon., l970; China 1995, Tai, l979
Microsphaeropsis sp. (Fungi Imperfecti, Coelomycete)[6]	CN, US[6]	Various	Leaf	Yes	Yes	PIN 309, 2003
Pestalotia guepinii (Desm.) Stey. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf	No	Yes	China, 1992; SBML, 2003
Phakopsora ehretiae Hirats. (Basidiomycetes, Uredinales)	CN	No additional hosts	Leaf	Yes	Yes	SBML, 2003; Spaulding, l96l; Tai, l979
Phoma sp. (Fungi Imperfecti, Coelomycetes)[6]	CN, US[6]	Various	Whole plant, Soil	Yes	Yes	PIN 309, 2003
Phomopsis sp. (Fungi Imperfecti, Coelomycetes)[6]	CN, US[6]	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
Pseudocercospora ehretiae-thyrsiflora Goh & Hseih (Fungi Imperfecti, Hyphomycetes)	CN	No additional hosts	Leaf	Yes	Yes	Goh and Hsieh, l989
Pseudocercosporella ehretiae (Sawada ex) Goh & Hsieh (Fungi Imperfecti, Hyphomycetes)	CN	No additional hosts	Leaf	Yes	Yes	Anon., l970; Goh and Hseih 1989
Uncinula ehretiae Keissl. (Ascomycetes, Erysiphales)	CN	No additional hosts	Leaf	Yes	Yes	SBML, 2003; Tai, 1979; Tanda and Su, 1995
Uredo ehretiae Barclay (Basidiomycetes, Uredinales)	CN	No additional hosts	Leaf	Yes	Yes	China, 1995; Spaulding, l96l; Tai, l979
Uredo garanbiensis Hirats. & Hash. (Basidiomycetes, Uredinales)	CN	No additional hosts	Leaf	Yes	Yes	Anon., l970; China 1995
NEMATODA						
Aphelenchida						
Aphelenchoides besseyi Christie	CN, US	Polyphagous	Leaf, Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a
Aphelenchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a

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Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Dorylaimida						
Dorylaimidae sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Dorylaimus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996b
Xiphinema brasiliense Lordello[1]	CN[1]	Polyphagous	Root, Soil	Yes[1]	Yes	Anon., 1984; EPPO, 1996b
Xiphinema sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Tylenchida						
Criconemella sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Helicotylenchus dihystera (Cobb) Sher.	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a, b; Queneherve *et al*., 1998
Helicotylenchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Hirschmanniella sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Meloidogyne sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996b
Meloidogyne incognita (Chitwood)	CN, US	Various	Root, Soil	No	Yes	Anon., 1984; USDA, 2003
Paratrophurus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Pratylenchus sp.	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
Pratylenchus brachyurus (Godfrey) Filipjev & Schuurmans Stekhoven	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996b
Rotylenchus robustus (deMan) Filipjev	CN, US	Polyphagous	Root, Soil	No	Yes	EPPO, 1996b
Tylenchorhynchus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Tylenchorhynchus crassicaudatus Williams	CN	*Musa*, *Oryza*, *Saccharum*, *Sorghum*	Root, Soil	Yes	Yes	EPPO, 1996a, b; Lin and Chiu, 1971; Rodriguez and Ayala, 1977; Williams, 1960
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee & Dasgupta	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
Tylenchus sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Triplonchida						
Trichodorus sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
MOLLUSCA						
Bradybaenidae						
Acusta ravida (Benson)	CN	Polyphagous	Whole plant, Soil	Yes	Yes	China, 1995; Likhachev and Rammelmeier, 1962

Table 3. Pests Associated with *Ehretia microphylla* in China.						
Pest	Geographic Distribution[1]	Additional Host Genera[2]	Plant Part Affected[3]	Quarantine Pest	Follow Pathway	References
Bradybaena similaris (Ferussac)	CN, US	Polyphagous	Whole plant, Soil	No	Yes	Chang and Chen, 1989; China, 1994; Dundee, 1970; Yen, 1943
Helicarionidae						
Helicarionidae sp.[6]	CN, US[6]	Various	Whole plant, Soil	Yes	Yes	PIN 309, 2003
Philomcidae						
Meghimatium sp. (= *Incilaria* sp.)	CN, US	Unknown	Unknown	Yes	Yes	China, 1994, 1995
Subulinidae						
Opeas sp.[6]	CN, US[6]	Various	Whole plant, Soil	Yes	Yes	PIN 309, 2003
Succineidae						
Succinea horticola Reinhart	CN	Polyphagous	Whole plant, Soil	Yes	Yes	PIN 309, 2003
Succinea sp.[6]	CN, US[6]	Various	Whole plant, Soil	Yes	Yes	PIN 309, 2003

[1]Geographic Distribution: CN - China, US - United States, FL - Florida, HI - Hawaii, MA – Massechusettes, PR – Puerto Rico, VI – U.S. Virgin Islands. Individual states are listed only if the pest is reported in less than five States or US territories. The nematode *Xiphinema brasiliense* was identified in Putnam County, Florida in 1959 (Lehman, 2002) and in California in 1974 (Hackney, 2003). The Society of Nematology personal communication reference to its presence in Florida may have been the same1959 isolation (Anon., 1984; Handoo, 2003). There appears to be no other reports of *X. brasilense* in the United States. For the purpose of this document, it is considered a quarantine pest because it was not identified in the United States in at least the last 25 years. Analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

[2]Polyphagous means the species feeds and reproduces on multiple hosts in multiple plant families. Various means different species use a variety of hosts.

[3]Plant Part Affected: Inflor. = inflorescence.

[4]The following pests are generalist feeders that were not listed as present on *Ehretia* in Chinese penjing gardens (China, 1995): *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis*, *Helicoverpa armigera*, *H. assulta*, *Icerya aegyptiaca*, *I. seychellarum*, *Mamestra brassicae*, *Phyllophaga titanis*, *Spodoptera litura*, *Sympiezomias velatus*, *Tridactylus japonicus* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Ehretia* is not a host of these pests. In 1996, some of these pests were assessed as following the pathway due to their generalist habits, but current information shows that these pests are not likely to follow the pathway of this importation.

[5] Although this pest has a limited distribution in the United States, it is not under Official control and does not meet the definition of a quarantine pest (FAO, 2002). However, analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

[6]These organisms have been intercepted by PPQ during inspections of these plants. Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. However, the particular taxon, at the level identified, is represented in the United States, *e.g.*

Diaspididae sp.

The unknown taxonomic status associated with species of "*Austropelea allulua*" and "*Calyptozele*" was prompted by a submission of these names by the ASIQ (China, 1995), which we could not subsequently substantiate as having known equivalents in the scientific literature. Literature searches did not find any synonymy to other existing genera. We therefore excluded these ambiguous names from consideration in this analysis because they are not known, valid species names.

The interceptions on bonsai from China (EPPO, 1996a, b) do not explicitly link the host to the intercepted pest. Based on these reports, all the intercepted pests are ascribed to *Ehretia* in this document. The newly described Acarina, *Xenotarsonemus biangulus*, is not listed as a quarantine pest and is likely to follow the pathway because it occurs on epiphytic mosses on the bark of *Ehretia*. It does not appear to be a pest (Lin *et al.*, 2000). *Pieris canidia* was intercepted once, by PPQ, on any host (PIN 309, 2003), and is therefore, considered and anomaly as it apppears to be host specific to Brassicaceae (Anon., 2003b). These species are not further analyzed for these reasons.

The biological hazard of organisms not identified to the species level was not directly assessed. In this risk assessment, this applies to: *Aphis* sp., Coccidae, *Colletotrichum* sp., Cucurlionidae, *Leptosphaeria* sp., *Microsphaeropsis* sp., *Phoma* sp., *Phomopsis* sp., *Phycitinae* sp., *Pseudaulacaspis* sp., *Rhizoecus* sp., and *Saissetia* sp. Stakeholder comments suggested that even if USDA did not have information about specific quarantine species, it should assume that they exist. That approach (specifically, assuming there are hazards without evidence to identify these hazards) is not consistent with international guidelines or agreements. It is reasonable, however, to assume that the biologies of congeneric organisms are similar and can be related to organisms that are analyzed and that specific, applicable, mitigations that target biologically similar groups (similar in a phytosanitary-relevant sense: meaning similar treatments/controls apply) will apply. For example, the analysis of the nematodes *T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense* is considered applicable to incompletely identified nematodes such as: *Aphelenchus* sp., *Paratrophorus* sp., *Criconemella* sp., Dorylaimidae sp., *Dorylaimus* sp., *Helicotylenchus* sp., *Hirschmanniella* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Trichodorus* sp., *Tylenchorhynchus* sp., *Tylenchus* sp., and *Xiphinema* sp. The biological information available for *Rhizoecus hibisci* is used to analyze *Rhizoecus* sp. *Macrophoma ehretiae* literature reasonably encompasses the Imperfect Fungi (primarily in the Coelomycetes), such as *Colletotrichum* sp., *Phoma* sp. and *Phomopsis* sp. These fungi are likely to be susceptible to similar control measures.

Many of the pests in Table 3 identified only to the order, family or generic level are based on PPQ interceptions from permit cargo of *Ehretia (Carmona) microphylla*. Often the pest could not be completely identified because the intercepted life stage lacks structures that allow identification to species. This applies to the interceptions of Coccidae, Curculionidae, Phycitinae and other genera. Lack of species identification may indicate the limits of the current taxonomic knowledge, the life stage or the quality of the specimen submitted for identification. If they could be identified, these pests may or may not belong to quarantine pest species. The pests identified only to higher taxa may actually belong to a non-quarantine species already addressed in the document, *e.g.*, the Coccidae includes non-quarantine pests like *Saissetia olea*.

The quarantine pests that are likely to follow the pathway of importation on species of *E. microphylla* from China are summarized in Table 4.

Table 4. Quarantine Pests Likely to Follow Pathway on *Ehretia microphylla* from China	
ARTHROPODA *Rhizoecus hibisci* Kawai & Takagi (Homoptera: Pseudococcidae) **MOLLUSCA** *Acusta ravida* (Benson) *Succinea horticola* Reinhart (Succineidae) **NEMATODA** *Xiphinema brasiliense* Lordello (Xiphinematidae) *Tylenchorhynchus crassicaudatus* Williams (Belonolaimidae) *Tylenchorhynchus leviterminalis* Siddiqi, Mukherjee & Dasgupta (Belonolaimidae)	**FUNGI** *Macrophoma ehretiae* Cooke & Mass. (Fungi Imperfecti, Coelomycetes) *Phakopsora ehretiae* Hirats. (Basidiomycetes, Uredinales) *Pseudocercospora ehretiae-thyrsiflora* Goh & Hseih (Fungi Imperfecti, Hyphomycetes) *Pseudocercosporella ehretiae* (Sawada ex) Goh & Hsieh (Fungi Imperfecti, Hyphomycetes) *Uncinula ehretiae* Keissl. (Ascomycetes, Erysiphales) *Uredo ehretiae* Barclay (Basidiomycetes, Uredinales) *Uredo garanbiensis* Hirats. & Hash. (Basidiomycetes, Uredinales)

E. Analysis of Quarantine Pests

The undesirable consequences that may occur from the introduction of quarantine pests are assessed within this section. For each quarantine pest, the Pest Risk Potential is calculated by summing the values for the Consequences of Introduction and the Likelihood of Introduction.

The major sources of uncertainty present in this risk assessment are similar to those in other risk assessments. They include the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992). To address this last source of uncertainty, the lists of factors were interpreted as illustrative and not exhaustive. This implies that additional biological information, even if not explicitly part of the criteria, can be used when it informs a rating. Sources of uncertainty in this analysis stem from the quality of the available biological information (Gallegos and Bonano, 1993), and the inherent, natural biological variation within a population of organisms (Morgan and Henrion, 1990).

Consequences of Introduction

This portion of the analysis considers negative outcomes that may occur when the quarantine pests identified as following the pathway of *E. microphylla* penjing plants from China are introduced into the United States. The potential consequences are evaluated using the following five Risk Elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These risk elements reflect the biology, host range and climatic and geographic distribution of each pest, and are supported by biological information on each of the analyzed pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) based on the criteria as stated in the Guidelines (APHIS, 2000). The summation of the points for each risk rating is the cumulative value for the Consequences of Introduction (Table 5). A cumulative value of 5 to 8 points is considered Low risk for the Consequences of Introduction, 9 to 12 points is Medium, and 13 to 15 points is considered High (APHIS, 2000).

Risk Element 1: Climate/Host Interaction

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants and suitable climate are present. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (ARS, 1960) with potential host plants and suitable climate.

In general, the varied climate in China corresponds to many of the climatological regions in the United States because they are at similar latitudes and range from coastal to mountainous regions (Hou, 1983). Penjing plants of *E. microphylla* are generally grown indoors because *Ehretia* prefers 60 to 72 degrees in winter, and only tolerates occasional dips into the forties (Anon., 2003; Caine and Zane, 2003). Protection from extreme heat is recommended for the summer, and the plant does not tolerate drafts (Anon., 2003; Caine and Zane, 2003). Based on these reported temperature preferences and the range (NRCS, 2003), three U.S. Hardiness Zones will support outdoor *E. microphylla* populations (USDA, 1960). The risk rating of Medium (2) is given for each of these species for the Climate-Host Interaction Risk Element.

Risk Element 2: Host Range

The risk posed by a plant pest depends on both its ability to establish a viable, reproductive population and its potential for causing plant damage. This risk element assumes that the consequences of pest introduction are positively correlated with the pest=s host range. Aggressiveness, virulence and pathogenicity also may be factors. The consequences are rated as a function of host range and consider whether the pest can attack a single species or multiple species within a single genus, a single plant family, or multiple families. The large number of hosts, in multiple plant families, attacked by these pests warrants a risk rating for Host Range of High (3) for all of the pests unless otherwise noted.

Rhizoecus hibisci feeds on: *Buxus, Calibanus, Carex, Chusquea, Crinum, Cryptanthus, Cuphea, Dichorisandra, Dieffenbachia, Dioscorea, Hakonechloa, Hibiscus, Nerium, Pelargonium, Phoenix, Rhaphis, Sabal, Sageretia, Serissa, Zelkova,* and *Zingiber* (CPC, 2002).

Snails (*A. ravida* and *S. horticola*) feed on foliage, flowers and fruit from various plant species, especially in greenhouses (Godan, 1983; Robinson, 2003), so identifying specific Ahosts@ is likely to underestimate the full range of plants that they can feed on. As an example of this diversity, a listing of plants intercepted with *S. horticola* from China includes: *Buxus*, *Carmona*, *Chamaedorea*, *Dracaena*, *Pinus*, *Serissa* and *Zelkova* (PIN 309, 2003).

The host range for *M. ehretia* includes *Buxus* spp., *Ehretia formosana* and *E. resinosa* (Boraginaceae) (ARS, 2001), so the risk rating is Medium (2). The other fungi (*Phakopsora ehretiae*, *Pseudocercospora ehretiae-thyrsiflora*, *Pseudocercosporella ehretiae*, *Uncinula ehretiae*, *Uredo ehretiae* and *U. garanbiensis*) are reported only on *Ehretia* (Table 3) so the risk rating is Low (1).

The host range for the stunt nematode *T. crassicaudatus* includes *Musa* (Zhang *et al*., 1995), *Oryza* (Lin and Chiu, 1971), *Saccharum* (Williams, 1960), and *Sorghum* (Rodriguez and Ayala, 1977). The hosts for *T. leviterminalis* include: *Canarium* (Zhang *et* al., 2002), *Dimocarpus* (Liu and Zhang, 1999), *Rosa* (Pathak and Siddiqui, 1997), *Lycopersicon* (Campos and Sturhan, 1987), *Musa* (Campos *et al*., 1987; Zhang *et al*., 1995), *Oryza* (Campos *et al*., 1987), and *Saccharum* (Talavera *et al*., 2002). The host range for *X. brasiliense*, includes *Carica*, *Cocos*, *Piper*, *Podocarpus* (Arias *et al*., 1995), *Citrus* (Crozzoli *et al*., 1998), *Croton* (Zem, 1977), *Nicotiana*, *Mangifera*, *Theobroma* (CPC, 2002), *Prunus* and *Vitis* (Maximiniano *et al*., 1998), and *Solanum* (Charchar, 1997).

Risk Element 3: Dispersal Potential

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pest=s impact may be expressed within the importing country or region and is related to the pest=s reproductive potential, inherent mobility, and external dispersal facilitation modes. Factors for rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance.

In the United States, *E. microphylla*, as bonsai plants, are grown indoors because the plants do not tolerate cold and drafts (Anon., 2003; Caine and Zane, 2003). The possibility of mobile pests migrating to outdoor native host plants, particularly during transport, cannot be precluded.

Rhizoecus hibisci is associated with soil and the roots of plants (McKenzie, 1967; Hata *et al*., 1996; Kosztarab, 1996). Adults and nymphs may crawl out of pot drainage holes or be dispersed in drained water into other pots in a greenhouse (Hata *et al*., 1996; McKenzie, 1967) so local dispersal within a greenhouse can occur and long-distance transport occurs as plants are traded in commerce (EPPO, 1996a; Hata *et al*., 1996). The dispersal potential risk rating is Medium (2).

Snails are spread in commerce, and due to their hermaphroditism, one organism can start a population (Anon., 2003c; Barker, 2002; Godan, 1983). *Acusta ravida* may lay over 600 eggs/season and is increasingly widespread, in China, because modern agricultural practices provide favorable habitats (Barker, 2002). *Succinea horticola* Reinhart, the most important species of its family, is a very severe pest of greenhouse plants and grasses (AFPMB, 1993). It is found in China, Japan, Okinawa, Greece and Italy (AFPMB, 1993). Although this species is not listed as a Atraveling species@, succineids are difficult to identify to the species level (Robinson, 1999). Currently, snail infestations are of heightened concern to APHIS-PPQ because of increase in volume of transported materials and the establishment of the Channeled apple snail, *Pomacea caniculata* (Lamarck) in California and Texas (Robinson, 1999; Smith and Fowler, 2002). The dispersal potential risk rating is High (3).

Macrophoma ehretia, Pseudocercospora ehretiae-thyrsiflora and *Pseudocercosporella ehretiae* are in genera where spores are discharged from fruiting structures and then dispersed primarily by rain and wind (Agrios, 1997; Pirone, 1978). The spores of *Uncinula ehretiae* also are water splashed, so the rating for these pathogens is Medium (2) because dispersal to nearby plants is likely to be limited by water availability and movement. The fungi that produce aerially disseminated spores (Agrios, 1997), such as *Phakopsora ehretiae*, *Uredo ehretiae* and *U. garanbiensis*, are rated High (3) because of their relatively higher ability to be disseminated long distances.

The nematodes of concern, *T. crassicaudatus, T. leviterminalis* and *X. brasiliense*, are all migratory parasites so short-distance or local dispersal will occur when infested potted plants are placed in contact with soil (Agrios, 1997; Jones and Benson, 2001; Sikora, 1992). Long distance dispersal will occur through commerce. The natural dispersal potential risk rating is Low (1).

Risk Element 4: Economic Impact

Introduced pests cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included effect yield or commodity quality, plant mortality, disease vector, increased costs of production including pest control costs, lower market prices, effect market availability, increase research or extension costs, or reduce recreational land use or aesthetic value.

In the greenhouse, *Rhizoecus hibisci* is a pest of ornamentals that can cause serious damage to roots (Kawai and Takagi, 1971) but it does not appear to be damaging outside of greenhouses in Hawaii (Hata *et al*., 1996) so the rating is Medium (2).

Feeding by *A. ravida* can defoliate major crops such as cotton, cabbages and legumes, and yield losses up to 25 percent occurred in China (Barker, 2002). Mollusk feeding also reduces the visual quality of the plant, the available photosynthetic surface area, and some mollusks clip succulent plant parts (Godan, 1983; Ohlendorf, 1999; Lai, 1984). Deep plowing and the application of chemicals, in combination with hoeing and raking to expose eggs, is necessary for good control of *A. ravida* (Barker, 2002). It is anticipated that if *A. ravida* or *S. horticola* are introduced into the United States, there will be a need for similar control measures, so the rating is High (3).

Leaf-spots caused by fungal pathogens reduce the the market value of plants when observed by potential buyers (Agrios, 1997; Pirone, 1978) because they reduce visual quality, available photosynthetic area, and plant vigor (Agrios, 1997; Jarvis, 1992; Kahn and Mathur, 1999; Pirone, 1978). For all the fungi, environmental conditions needed for infection do not continually occur (Agrios, 1997; Pirone, 1978; Van der Plank, 1963). Powdery mildews, such as *Uncinula ehretiae*, can severely reduce the photosynthetically active area of leaves under favorable conditions (Agrios, 1997; Pearson and Goheen, 1988; Pirone, 1978; Tanda and Su, 1995). Uncontrolled rust epiphytotics can rapidly kill host plants (Agrios, 1997; Arthur, 1962; Van der Plank, 1963). But all of the fungi (except for *Macrophoma ehretiae*) are reported only on *Ehretia* which is not a primary component of U.S. ecosystems or the economy so their economic impact ratings are Low (1). In contrast, the host range for *Macrophoma ehretiae* includes unidentified species of *Buxus* which are more widely planted throughout the country than *Ehretia*, so the rating for this fungus is Medium (2).

Nematode infestations are cryptic and unlikely to be observed except as reduced plant vigor. Although local dispersal may lead to permanent infestations within a greenhouse or nursery (Agrios, 1997; Jones and Benson, 2001), minimal long-distance dispersal affecting all potential hosts is expected unless infected *Ehretia* are used as landscape ornamentals and alternative hosts are nearby. Even if this occurs, minimal economic impact is likely for several reasons: many of the hosts are not grown throughout the continental United States, *e.g. Saccharum*, *Citrus*; organic mulches and green manure may be antagonistic to nematode populations (Sikora, 1992) and the pantropical *X. brasiliense* (Luc and Coomans, 1992) is associated with native forest flora (Fortuner and Couturier, 1983). For these reasons, the economic impact rating for
T. crassicaudatus, *T. leviterminalis* and *X. brasiliense* is Low (1).

Risk Element 5: Environmental Impact

The ratings for this risk element are based on three aspects: the capability of the pest to disrupt native plants based on the pest=s habits exhibited within its current geographic range; will the pest=s presence will stimulate the need for additional chemical or biological control programs and, is the pest is likely to directly or indirectly impact species listed as Threatened or Endangered (50 CFR ' 17.11-12) by infesting or infecting a listed plant that is in the same genus as its hosts. When a pest is known to infest or infect other species within the same genus, and feeding preference data does not exist with the listed plant, then the listed plant is assumed to be a potential host.

Insect pests exhibit wide host ranges in China, but the most likely effect of many of these pests is to reduce vigor although young plants can be killed (Agrios, 1997; Carter, 1984; Borror *et al*., 1989; Hill, 1987).

Sustained epidemics over time are often needed for leaf-spot pathogens to directly kill host plants (Agrios, 1997; Van der Plank, 1963). While rust fungi are devastating to susceptible crops under intense agricultural production practices, the spread of rusts in non-managed situations is likely to be highly dependent on both plant density and prevailing environmental conditions (Agrios, 1997; Gilbert, 2002; Van der Plank, 1963).

Several of the pests have hosts that are in the same genus as species that are listed as Threatened, Endangered or Candidates for listing (USFWS, 2002). Potential hosts for *R. hibisci* could include: the Endangered species of *Buxus vahlii* found in Puerto Rico and the Virgin Islands; the Endangered *Carex albida* and *C. lutea* in California and North Carolina, respectively; the Threatened *C. specuicola* in Arizona and Utah; the Endangered *Hibiscus arnottianus* ssp. *immaculatus*, *H. brackenridgei*, *H. clayi*, and *H. waimeae* ssp. *hannerae* in Hawaii; and the Candidate *H. dasycalyx* in Texas (NatureServe, 2003). Potential hosts for *Tylenchorhynchus leviterminalis* could include the Endangered *Euphorbia haeleeleana* in Hawaii and the Threatened *E. telephioides* in Florida (NatureServe, 2003). Potential hosts for *Xiphinema brasiliense* include the Endangered *Prunus geniculata* in Florida, and the Endangered species *Solanum drymophilum* in Puerto Rico, *S. incompletum* and *S. sandwicense* in Hawaii, and the Candidate *S. nelsonii* in Hawaii (NatureServe, 2003). The environmental risk rating for *R. hibisci*, *T. leviterminalis*, and *X. brasiliense* is High (3).

The environmental risk rating is High (3) for the snails because all listed plant species are at-risk from these non-host specific organisms. For the fungus, *M. ehretiae*, and nematode, *T. crassicaudatus*, there are no other hosts that are in the same genera as species listed as Threatened, Endangered or Candidate species for listing (USFWS, 2002). For all these pests, the environmental risk rating is Medium (2). For the remaining fungal pathogens, *Phakopsora ehretiae*, *Pseudocercospora ehretiae-thyrsiflora*, *Pseudocercosporella ehretiae*, *Uncinula ehretiae*, *Uredo ehretiae* and *U. garanbiensis*, the rating is Low (1) due to their extremely narrow host ranges combined with the general low prevalence of *Ehretia* in U.S. native ecosystems.

Table 5. Risk Ratings for the Consequences of Introduction[1].

Pest	Climate / Host	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Consequences of Introduction
Rhizoecus hibisci	Medium (2)	High (3)	Medium (2)	Medium (2)	High (3)	Medium (12)
Acusta ravida *Succinea horticola*	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
Macrophoma ehretiae	Medium (2)	Med. (2)	Med. (2)	Med. (2)	Med. (2)	Medium (10)
Phakopsora ehretiae		Low (1)	High (3)	Low (1)	Low (1)	Low (8)
Pseudocercospora ehretiae-thyrsiflora		Low (1)	Med. (2)	Low (1)	Low (1)	Low (7)
Pseudocercosporella ehretiae		Low (1)	Med. (2)	Low (1)	Low (1)	Low (7)
Uncinula ehretiae		Low (1)	Med. (2)	Low (1)	Low (1)	Low (7)
Uredo ehretiae		Low (1)	High (3)	Low (1)	Low (1)	Low (8)
U. garanbiensis		Low (1)	High (3)	Low (1)	Low (1)	Low (8)

Table 5. Risk Ratings for the Consequences of Introduction[1].						
Pest	Climate / Host	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Consequences of Introduction
Tylenchorhynchus crassicaudatus	Medium (2)	High (3)	Low (1)	Low (1)	Medium (2)	Medium (9)
T. leviterminalis					High (3)	Medium (10)
Xiphinema brasiliense					High (3)	Medium (10)

[1] Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms within that taxa for that risk element.

Likelihood of Introduction

The Likelihood of Introduction for a pest is rated relative to six factors (APHIS, 2000). The assessment rates five of these areas based on the biological features exhibited by the pest=s interaction with the commodity. These areas represent a series of independent events that must all take place before a pest outbreak occurs. These five areas are: the availability of post-harvest treatments, whether the pest can survive through the interval of normal shipping procedures, whether the pest can be detected during a port of entry inspection, the likelihood that the pest will be imported or subsequently moved into a suitable environment, and the likelihood that the pest will come into contact with suitable hosts. The value for the Likelihood of Introduction is the sum of the ratings for the Quantity Imported Annually and these biologically based areas (Table 6). The following scale is used to interpret this total: Low is 6-9 points, Medium is 10-14 points and High is 15-18 points.

<u>Risk Element 6, subelement 1: Quantity Imported Annually</u>

The rating for this risk element is based on the amount reported by the country of proposed export converted into standard units of 40-foot long shipping containers (APHIS, 2000; Cargo Systems, 2001). The quantity of *E. microphylla* to be shipped annually from China is projected to fill ten to one-hundred 40-foot shipping containers. For this reason, this element is rated as Medium (2).

<u>Risk Element 6, subelement 2: Survive Postharvest Treatment</u>

Whole trees are not likely to receive postharvest treatments such as irradiation, methyl bromide, or steam sterilization because there is no Aharvest@ of the commodity, and the types of treatments that would kill pests are also likely to kill the trees. Like other post-harvest treatments, the presence of artificial media and/or pots requires specific testing to ensure the efficacy of any proposed post-harvest treatments (Paull and Armstrong, 1994). For this reason, all of the pests are rated High (3).

<u>Risk Element 6, subelement 3: Survive Shipment</u>

This sub-element evaluates the mortality of the pest population during shipment of the commodity. Shipments of *E. microphylla* are not likely to be refrigerated and may spend two to four weeks in maritime transit to the United States (Cargo Systems, 2001; AQIM, 2002). Direct air shipments will not take this long. Interceptions by PPQ of the various pests (on any host) is evidence that they can survive the ambient transport conditions (PIN 309, 2003). The rating for all of the pests is High (3).

Risk Element 6, subelement 4: Not Detected at Port of Entry
In general, careful inspection for the mobile life stages of insect pests can detect them despite their small size (Rosen, 1990). The very high number of interceptions of these pests from any country and on any commodity confirms that trained inspectors can find insect pests in shipments (PIN 309, 2003). The mealybug, *R. hibisci*, feeds on the roots of its host (Williams, 1996). If present, the microscopic nematodes (*T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense*) will swim in the water associated with the roots of the plants (Agrois, 1997) and remain undetected. The snails *A. ravida* and *S. horticola* are likely to be detected only if slime trails are present, but eggs and populations resident in the growing medium are likely to evade detection without destructive sampling (Burch, 1962; Godan, 1983; Lai, 1984). For these reasons, all of these pests are rated High (3) because they are unlikely to be detected during a port of entry inspection. While stem and leaf spot symptoms are easily detected (Pirone, 1978), latent infections or dormant spores present on the plants will be undetected, so the rating for all of the fungi is Medium (2).

Risk Element 6, subelement 5: Imported or Moved To An Area Suitable for Survival
This sub-element considers the geographic location of likely markets and the chance of the commodity moving to locations suitable for the pest's survival. Plants for planting that arrive in the United States are distributed according to market demand. All of the arthropod, mollusk and nematode pests are rated Medium (2) because non-cultivated, landscape and ornamental hosts are widespread throughout the United States (Bailey *et al*., 1976; NRCS, 2003) and outdoor locations for the artificially dwarfed plants are likely to provide suitable habitats for the pests even if the original *Ehretia* host is not available outdoors (Anonymous, 2003; Craine and Zane, 2003). Fungi often need specific humidity and temperature ranges to infect (Agrios, 1997; Van der Plank, 1963), so while indoor plants may be in highly suitable environments for fungal infection, the chance of fungal spores reaching outdoor suitable habitats appears more remote. When these fungi (*Macrophoma ehretiae*, *Phakopsora ehretiae*, *Pseudocercospora ehretiae-thyrsiflora*, *Pseudocercosporella ehretiae*, *Uncinula ehretiae*, *Uredo ehretiae* and *U. garanbiensis*), with their limited host ranges, are considered in light of the preferred indoor growth of the *Ehretia*, risk rating for the fungi is Low (1).

Risk Element 6, subelement 6: Contact with Host Material
Lack of suitable hosts restricts the opportunities for pests to establish populations. While passive factors such as wind, water, or animals may aid in the dispersal of stages of the insect pests (Kosztarab and Kozar, 1988; Rosen, 1990), suitable hosts must be available to sustain a pest population over time. Plants grown in indoor residential areas are likely to be widely separated from native host plant populations, but the close proximity of outdoor plant populations to host material provides a pathway for pests to become established (Beardsley and Gonzalez, 1975). The numbers and types of hosts available to the pest, therefore, becomes a limiting factor for pests with a small host range, such as the fungi

Macrophoma ehretiae, *Phakopsora ehretiae*, *Pseudocercospora ehretiae-thyrsiflora*, *Pseudocercosporella ehretiae*, *Uncinula ehretiae*, *Uredo ehretiae* and *U. garanbiensis*, and are rated Low (1). Reduced dispersal capability will limit the contact with host material for the nematodes (*T. crassicaudatus*, *T. leviterminalis* and
X. brasiliense) because many of their hosts are not typically grown indoors in the United States, so contacting hosts will require escape from the indoor setting and subsequently finding a host. These pests are rated Medium (2). The mollusks (*A. ravida* and *S. horticola*) are rated High (3) because they are non-specific feeders (Robinson, 2003). The arthropod pest, *R. hibisci*, is rated High (3) because it is likely to establish indoor populations on ornamental plants and subsequently escape outdoors.

Table 6. Risk Ratings for the Likelihood of Introduction[1].

Pest	Quantity Imported Annually	Survive postharvest treatment	Survive shipment	Not detected at port of entry	Move to a suitable habitat	Find suitable hosts	Risk Rating
Rhizoecus hibisci	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
Acusta raivda *Succinea horticola*	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
Macrophoma ehretiae *Phakopsora ehretiae* *Pseudocercospora ehretiae-thyrsiflora* *Pseudocercosporella ehretiae* *Uncinula ehretiae* *Uredo ehretiae* *U. garanbiensis*	Medium (2)	High (3)	High (3)	Medium (2)	Low (1)	Low (1)	Medium (12)
Tylenchorhynchus crassicaudatus *T. leviterminalis* *Xiphinema brasiliense*	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	Medium (2)	High (15)

[1] Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms for that risk element.

F. Conclusion: Pest Risk Potential

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction is the value for the Pest Risk Potential (Table 7). The following scale is used to interpret this total: Low is 11-18 points, Medium is 19-26 points and High is 27-33 points. This is an estimate of the risks associated with this importation, and reduction of risk occurs through the use of mitigation measures.

The Pest Risk Potential for all of the arthropod and mollusk pests is High, and the Pest Risk Potential for all of the fungal pathogens is Medium. Pests with a Low Pest Risk Potential typically do not require mitigation measures other than port of arrival inspection, while a value within the Medium or High ranges indicates that specific phytosanitary measures, supplemental to port of arrival inspection, are necessary. As a stand-alone mitigation measure, port of arrival inspection is insufficient to provide phytosanitary security for the quarantine pests analyzed in this document, and the development of additional specific phytosanitary measures is recommended.

Table 7. Consequences of Introduction, the Likelihood of Introduction and the Pest Risk Potential.

Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
Rhizoecus hibisci	Medium (12)	High (16)	High (28)
Acusta ravida (Benson) *Succinea horticola*	High (14)	High (16)	High (30)
Macrophoma ehretiae	Medium (10)	Medium (12)	Medium (22)
Phakopsora ehretiae	Low (8)		Medium (20)
Pseudocercospora ehretiae-thyrsiflora	Low (7)		Medium (19)
Pseudocercosporella ehretiae	Low (7)		Medium (19)
Uncinula ehretiae	Low (7)		Medium (19)
Uredo ehretiae	Low (8)		Medium (20)
U. garanbiensis	Low (8)		Medium (20)
Tylenchorhynchus crassicaudatus	Medium (9)	High (15)	Medium (24)
T. leviterminalis	Medium (10)		Medium (25)
Xiphinema brasiliense	Medium (10)		Medium (25)

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